TROPICAL TESTS OF A SEAWATER MARKER (2)

R.J. SWINTON AND E. GELLERT

MRL-TR-90-19

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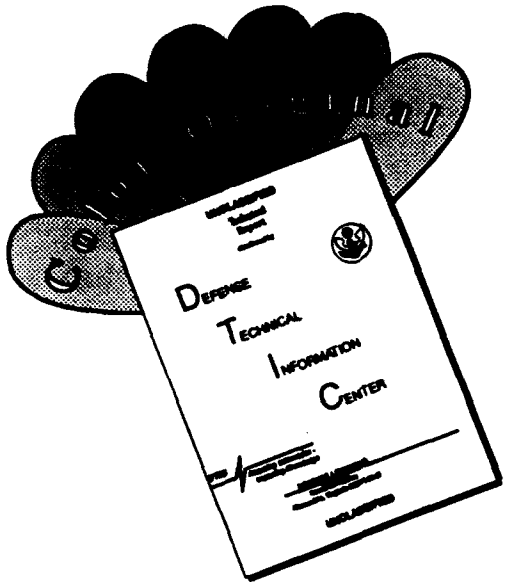

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Tropical Tests of a Seawater Marker

R.J. Swinton and E. Gellert

MRL Technical Report
MRL-TR-90-19

Abstract

A series of tests on the MRL seawater marker were carried out under tropical conditions for the following reasons:

(i) To examine the performance of fluorescein in tropical conditions,
(ii) To compare the MRL marker with the commercially available dye marker, and
(iii) To test a prototype, helicopter-deployed marker device.

Results confirmed that fluorescein, in the form used in the commercially available markers, performs poorly in tropical conditions, whilst the MRL marker was vastly superior. The helicopter marker device was deployed from a height of 50 m and was successful in creating a fast-acting, long-duration dye stain over a large area.

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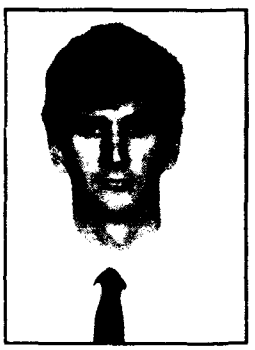

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Tropical Tests of a Seawater Marker

1. Introduction

MRL has developed and is in the process of patenting a new concept for seawater position markers [1] based on buoyant, slow-dissolving flakes that contain the highly visible dye fluorescein. The following commercial uses are envisaged for the new seawater marker flakes (see Figure 1):

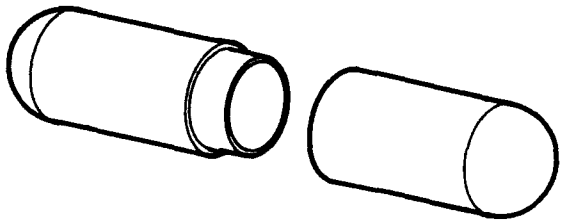
(i) In capsules, to be worn on safety vests and scuba divers' jackets.
(ii) In small canisters for use aboard pleasure craft and life rafts.
(iii) In sachets for air dropping from both helicopters and fixed wing aircraft.

It is generally felt by personnel engaged in search and rescue that fluorescein dye, as used in current commercial safety markers, is much reduced in marking efficiency when used in tropical waters, although no confirmatory data exist. This effect is thought to occur because of the reduced contrast with the lighter sea colours found in the tropics.

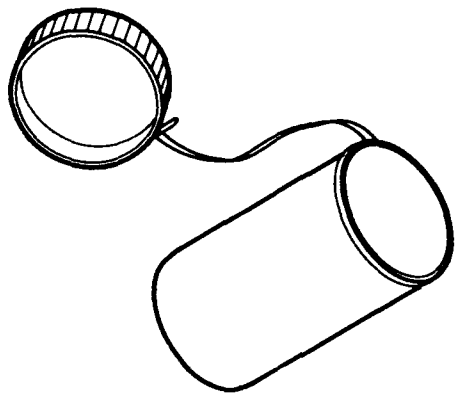
Current commercial markers allow the fluorescein to sink below the surface thus markedly reducing the fluorescent output, whereas the MRL marker flakes float on the surface and the fluorescein is slowly released. The MRL marker can display its fluorescent signal for several times the lifetime of the currently used, conventional fluorescent markers [2].

MRL Queensland conducted a trial in North Queensland (NQ) waters, adjacent to Kent Island at latitude 17°40′ S (approximately) on 25 October 1989. The primary purpose was to test the effectiveness of both the conventional seawater marker and the new MRL flake concept under tropical conditions. The following points were to be specifically addressed:

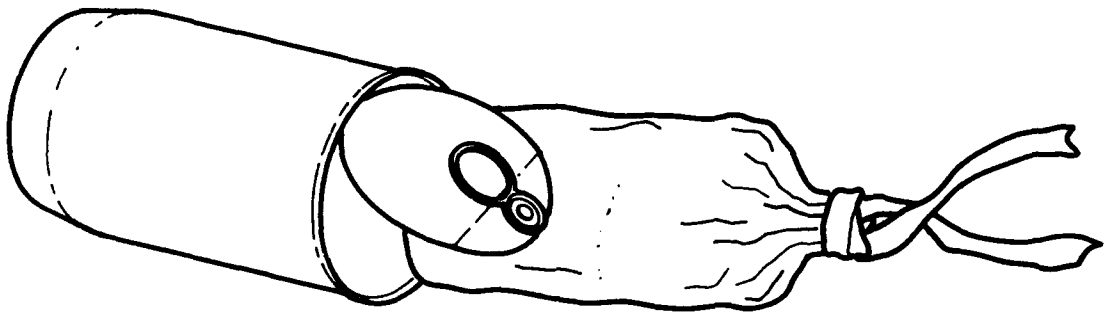
(i) Compare the performance of the conventional life raft dye marker (Pains-Schermuly brand "Fairway" sea marker, 100 g) to the suggested replacement MRL marker (40 g).
(ii) Evaluate both markers as search and rescue aids.
(iii) Test the effectiveness of a concept for an air-dropped MRL marine marker.



(a) As capsules, to be worn on safety-vests and "scuba-divers' jackets".



(b) As small canisters aboard pleasure-craft and life-rafts.



(c) As aerial-drop sachets for use by both helicopters and fixed wing aircraft.

***Figure 1** Commercial applications*

2. Environmental Considerations

Permission was obtained to conduct this experiment in the Great Barrier Reef Marine Park (GBRMP) from the GBRMP Authority and the Queensland National Parks and Wildlife Service under Permit No. G89/481 issued on the 19 October 1989.

The information in section 2.1 was tendered to these Authorities in order to obtain their authorisation.

2.1 Toxicity information with respect to Fluorescein

The dye used in the MRL seawater dye marker is fluorescein. It is described in the Colour Index as CI Acid Yellow 73, Constitution No. 45350, and is essentially the sodium salt of hydroxy-o-carboxyphenylfluorene.

In [3] it is stated that fluorescein is still under test for carcinogenesis by Standard Protocol as of December 1980. As yet results are reported as inconclusive. The disodium salt is reported as meeting criteria for proposed OSHA medical records rule: National Institute for Occupational Safety and Health (NIOSH) #:LM 5425000.

Toxicity is described as low [4] and it has been used medicinally, in a more purified form, as a 5% solution to be administered intravenously for diagnostic purposes such as the investigation of circulatory disorders. Miguel [5] states that "Under normal sanitary engineering uses of fluorescein dye, the toxicity hazard is low", in his work tracing stream waters for catchment areas. A further report [6] cites its uses in America for checking leakages in fresh water reservoirs.

Fluorescein has been used for many years as a seamarker dye and there is no record of damage to animal or marine lifeforms.

3. Experimental

3.1 Items Tested

A total of six (6) sea-marker dye-flake containers were sent to MRL Queensland. These were labelled 1 to 6 respectively and were in two forms:

(1) Nos. 1, 2 and 3. These were air-tight plastic canisters with tear-around plastic seals containing dye flake (see Fig. 1(ii)). The fluorescein flake content was 40 g.

(2) Nos. 4, 5 and 6. These were pop-lid type tennis ball canisters containing an inner, water-soluble PVA sachet of dye flake, tied with fluorescent trailing ribbon (see Fig. 1(iii)). These contained approximately 100 g of fluorescein flake.

(3) The commercial marine marker used for comparative purposes was the Pains-Schermuly brand "Fairway" sea marker dye. This consisted of a plastic sachet containing approximately 100 g of fluorescein dye activated by removing a tear-off perforated strip and immersing in the sea water.

After deployment of MRL canisters 1 and 2 (boat deployed) and 4 and 5 (air deployed) the testing team decided that enough information had been gathered to address the three separate purposes for conducting the trial.

3.2 *Trial Instructions*

3.2.1 *Resources used in trial*

a. Helicopter with video cameraman and observer equipped with 35 mm camera, for recording observations from the helicopter.

b. A small boat with pilot and observer/deployer equipped with 35 mm camera.

c. Observer on observation island equipped with both a 35 mm and video camera for recording deployed canisters.

3.2.2 *Records taken*

(1) Air temperature
(2) Water temperature
(3) Wind direction and speed
(4) Any rainfall
(5) Sea state
(6) Turbidity of sea (i.e. clear or dirty) - observers comments were taken as satisfactory
(7) Start time of experiment (initial dye deployment)
(8) The distance and elevation (height) at which helicopter observers both lost and reattained visual contact with the dye stains.

3.2.3 *Trial procedure*

Step 1. The experiment began by tethering the commercial fluorescein marker to a float buoy anchored 1 km north east (approximately) of the observation island. This was to act as both the reference point and for performance comparison with the MRL marker. Photographs and video were taken from the helicopter (see Figs 2 and 3).

Step 2. Canister number 1 was then deployed from the boat, approximately 15 min after step 1, by removing the tear seal and tossing the flake into the sea. The helicopter was used to record the event on video camera from a height of 150 m for a timespan of approximately 10 min.

Step 3. Approximately 15 min after step 2 canister number 2 was released at a position appproximately 50 m distant from previous dye stains to avoid intermingling.

Step 4. Approximately 10 minutes after step 2 the helicopter was directed to fly north away from the fluorescein dye mark and record the marker pattern from a height of 150 m. This was done so that the observers aboard the helicopter could report the approximate distance at which the dye mark was no longer visible. The helicopter was then requested to fly back toward the dye mark so that the observers could then report the distance when the dye mark became visible again. Video and still photographs of this manoeuvre were taken.

Step 5. The helicopter was then requested to repeat step 4 at a height of 1 500 m.

Step 6. The first of the sachets (No. 4) was then deployed from the helicopter from a height of approximately 30 m, again on the north east side of the observation island. The descent to the water surface was easy to follow with the aid of the bright red streamers. The observers in the boat photographed this event.

Step 7. The second pop-lid canister (No. 5) was deployed approximately 15 minutes after No. 4 from a height of 30 m.

Step 8. The dye stains created from the helicopter-deployment in Steps 6 and 7 were viewed from an altitude of 1 500 m out to the limit of visibility as was done in Step 5. The details were recorded on video for approximately 10 min. Again observers took photographs.

Step 9. Returning towards the helicopter-deployed stains at an altitude of 150 m, the distance from which the dye marks became visible again was recorded.

Step 10. The helicopter, on leaving the trial site an an altitude of 150 m, took video and still photographs of the residual dye stains from Steps 1, 2, 3, 6 and 7.

4. Trial Observations

The trial was conducted in clear, calm waters, with a water temperature of 27-28°C, in generally sunny conditions. The hydrological and meteorological data are given in Appendix 1. The trial area, workboat and helicopter circling pattern are discussed in Appendix 2.

The markers were deployed at approximately 15 min intervals in the sequence; commercial, MRL No. 1, 2 (from the boat), 4, 5 (from the helicopter at altitude 30 m). Helicopter observations were generally made from heights of 30, 150 or 1 500 m (see Appendix 3).

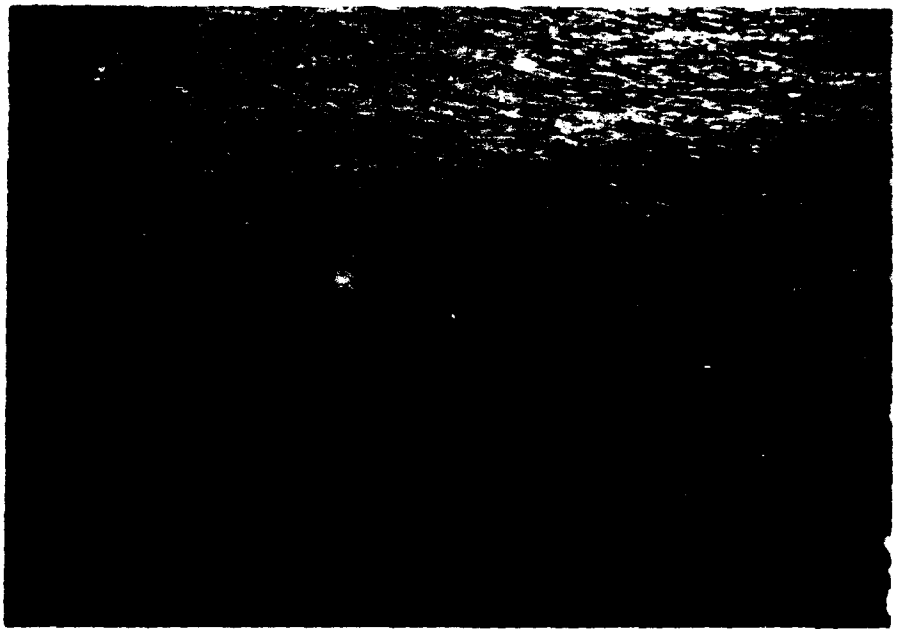


Figure 2: Depicts the inefficiency of the commercial dye marker.

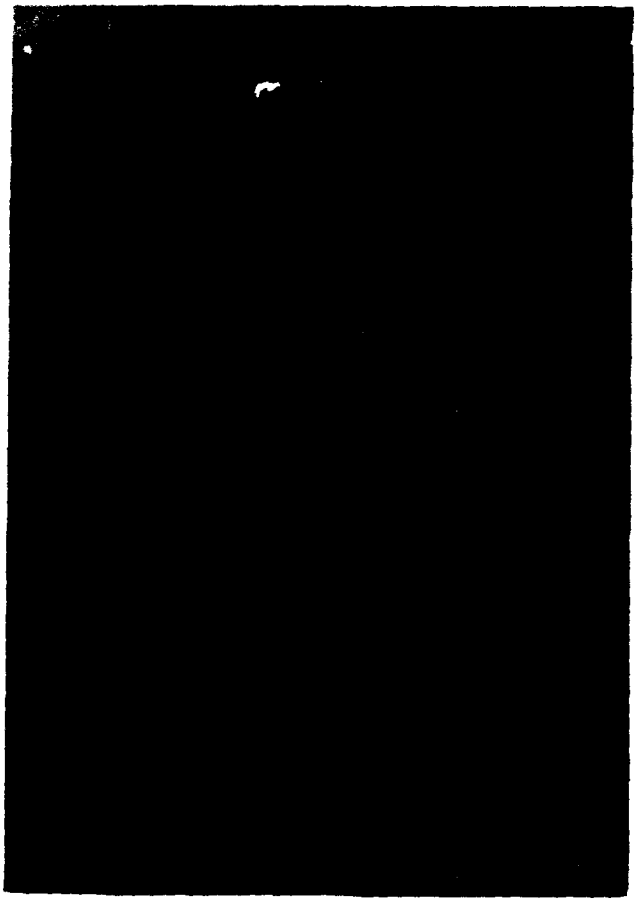


Figure 3: Depicts the MRL marker 10 min after deployment (next to boat) and the commercial marker (bottom centre) 30 min after deployment; taken from 150 m.

Figure 4: Depicts the 100 g commercial marker.

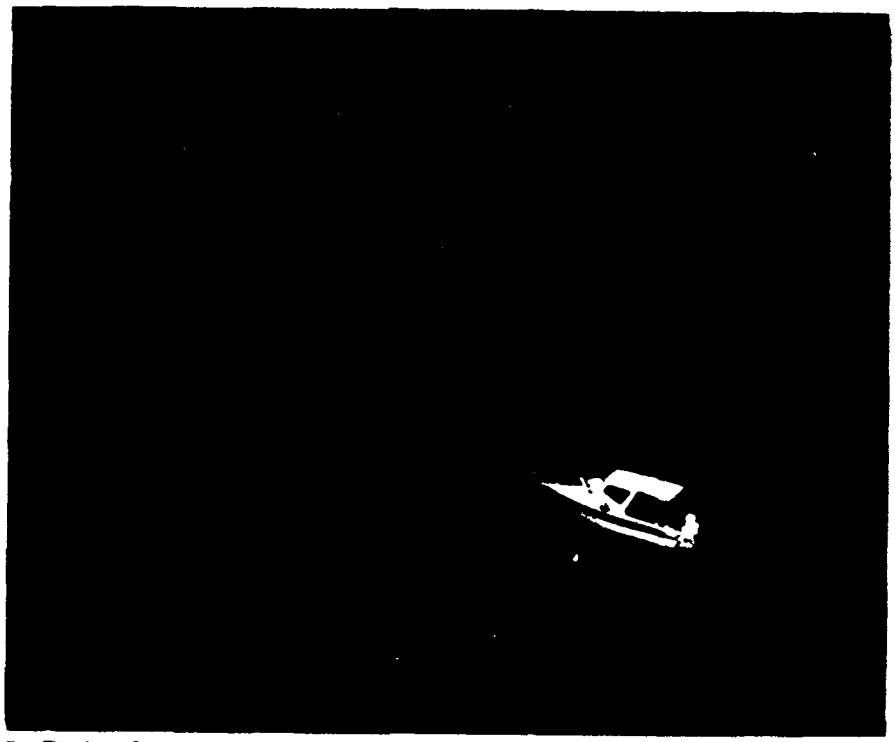


Figure 5: Depicts the 50 g MRL marker, after 30 min.

Marker No. 1, after a deployed time of about 10 min, see Figure 3, was lost from sight at an altitude of 150 m and a distance of about 3 km. On returning at 150 m, it was resighted at a distance of about 1.6 km (see Appendix 3).

Marker No. 2, after a deployed time of about 13 min, was almost lost from sight at a distance of 9 km and an altitude of 1 500 m. The helicopter returned prior to the point where the markers were lost from sight (see Appendix 3, 10.29 a.m.).

Marker No. 5, after a deployed time of 12 min, was lost from sight at approximately 4 km at an altitude of 150 m. Marker No. 4 with a deployed time of 24-1/2 min was also no longer visible at this position. They were re-sighted at a distance of approximately 2.5 km at altitude 150 m.

At an altitude of 1 500 m, the markers were lost from sight at approximately 10 km, at which time No. 5 had been deployed for 24 min. The pilot reported re-sighting the markers on the return trip at 6 to 7 km and a height of 1500 m. Figure 6 depicts MRL marker No. 1 at the left, after 45 min, No. 2 right, after 30 min and No. 3 centre after 5 min, from 1 500 m.

At an altitude of 300 m above the pattern markers No. 2, 4 and 5 were still clearly visible 64 min after the deployment of No. 2 (see Figs 4 and 5).

The island observers were stationed at a height of 90 m above sea level approximately 1 km south-west of the dye marker pattern (Fig. 7). They reported that the conventional marker was not sighted, markers 1 and 2 remained visible for 34 and 50 min respectively, and markers 4 and 5 (helicopter deployed) remained visible for 81 and 72 min respectively. They also reported that the markers were much more easily viewed when polaroid glasses were worn.

5. *Conclusions*

The considered opinion of many trained observers ([2] et al) that fluorescein dye sustains a drastic reduction in marking efficiency when used in tropical waters was found to be true for the conditions under which this test was conducted.

Figure 6: MRL marker No. 1 on left, after 45 min; MRL marker No. 2 on right, after 30 min; MRL marker No. 4 centre, 15 min (all from 1 500 m).

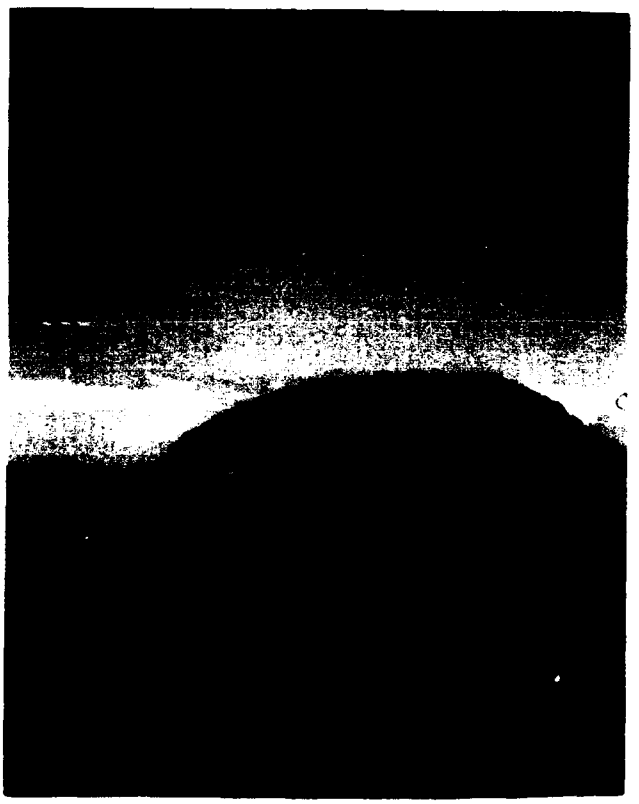


Figure 7: Island observers stationed at 90 m above sea level in background. MRL helicopter launched dye-pack, after 5 min.

The commercially available marker was found to be ineffective and could be sighted only at close ranges such that even the 150 mm buoy was also visible. Even though the dye signature from it was still being deployed after 2 hours its signal output was described as being "of little value" by the trial personnel. The new MRL markers were described as being "vastly superior". When viewed from approximately 1 km they gave a prominent signal for a duration of approximately 70-80 minutes. The helicopter deployed markers could be sighted from 6-7 km at 1 500 m.

Even though the MRL marker (40 g canister) was less than half the mass of the commercial marker the signal it produced was considered more than adequate, under the prevailing conditions, as a search and rescue aid.

The helicopter pilot and crew had no trouble opening and deploying the water-soluble sachets (from a height of 30 m) of the MRL markers. The marked spot took about 30-60 s to be visible and by 5 min the signal was highly visible and still disseminating. The aerial-deployed markers were considered very effective and have excellent potential to be a commercially marketable device.

6. Acknowledgements

The authors would like to thank the staff at MRL Queensland for carrying out this trial and the pilot and crew of the assisting helicopter from 35 Squadron, RAAF Base, Townsville.

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Appendix 1

Hydrological and Meteorological Conditions During the Trial

Pre-trial, 0900 h

Air temperature*	29°C	
Sea temperature at depth	0.5 m	27.7°C
	1.0 m	27.0°C
	1.5 m	27.0°C

Tide run - not able to be determined
Sea state - calm, less than 0.2 m swell
Wind run - zero
Turbidity - A 450 mm white disc remained visible at a depth of 10 m
Scattered cloud, mostly sunny over the trial area

Mid trial, 1020 h

Air temperature*		33°C	
Sea temperature at depth		0.5 m	27.4°C
		1.0 m	27.2°C
		1.5 m	27.1°C

Sea state - calm
Wind speed - 5 km/h (direction not determined, but generally south-easterly throughout the trial).

Tides	7.03 a.m.	high tide	1.80 m
	12.49 p.m.	low tide	0.46 m

No rainfall occurred through the trial

* The air temperatures reported were probably elevated by proximity to the boat. The air temperature at Cowley beach approximately 6 km to the south-west was about 28°C at 1030 h.

Appendix 2

The dye-marker pattern was deployed approximately 1 km north east of Kent Island. Water depth was between 15 and 30 m.

The length of the workboat is 6.3 m (for approximate scaling).

Circling the pattern from 30 m caused prominent sea-surface disturbance from the wash of the helicopter rotors.

There were high levels of narrow trails of what is believed to be algal scum which were present in the marker pattern throughout the trial. These have a smokey-brown colouration and may at times be confused with marker residue when viewing the photos or video.

The distance at which markers were lost from sight of the helicopter was estimated from the time elapsed during a 30 m/s cruise to the north. One min equals approximately one mile and distances were originally quoted in miles. The distance at which a marker was re-sighted was estimated by the helicopter pilot. The first run at 1 500 m was terminated just prior to sight being lost so that the schedule could be maintained.

Appendix 3

Schedule of events and observations recorded from the helicopter

Time	
9.44 a.m.	Commercial marker deployed 1-2 min elapsed before the dye stream was evident. The stream was narrow, long and indistinct, not intense.
9.58	MRL No. 1 deployed from the boat.
10.07	Flew north at altitude 150 m, speed 30 m/s.
10.08-3/4	Lost sight of No. 1, approximate distance 3 km, altitude 150 m. Resighted No. 1, approximate distance 1.6 km, altitude 150 m. Commercial marker not prominent from altitude 150 m when directly overhead.
10.16	MRL No. 2 deployed from the boat.
10.23-1/2	Flew north at altitude 1 500 m, speed 30 m/s.
10.28	Marker No. 1 indistinct but visible, marker No. 2 still clearly visible.
10.29	Helicopter returned to maintain schedule, at which point marker No. 1 not visible, marker No. 2 was still visible, but would probably have been lost sight of in the next km. Estimated distance for losing sight of marker No. 2 was 9 to 10 km at altitude 1 500 m. Marker No. 2 deployment time 13 min, marker No. 1 deployment time 31 min.
10.34	MRL No. 4 deployed from helicopter at altitude 30 m.
10.46-1/2	MRL No. 5 deployed from helicopter at altitude 30 m.
10.56	Flew north at altitude 150 m, speed 30 m/s.
10.58-1/2	Marker No. 5 (and others) no longer visible. Markers lost from sight at approximately 4 km at altitude 150 m. Pilot reported re-sighting the markers at approximately 2½ km at altitude 150 m.
11.04	Flew north at altitude 1 500 m, speed 30 m/s.

11.10-1/2	Marker No. 5 (and others) lost from sight at a distance of approximately 10 km at altitude 1 500 m. Marker No. 5 deployment time was then 24 min. Pilot reported re-sighting the markers at 6 to 7 km at altitude 1 500 m.
11.20	Circling pattern carried out at altitude 300 m. Markers No. 2, 4 and 5 still clearly visible with No. 2 now deployed for 64 min, No. 4 deployed for 46 min, and No. 5 deployed for 33 min.

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Results confirmed that fluorescein, in the form used in the commercially available markers, performs poorly in tropical conditions, whilst the MRL marker was vastly superior. The helicopter marker device was deployed from a height of 50 m and was successful in creating a fast-acting, long-duration dye stain over a large area.